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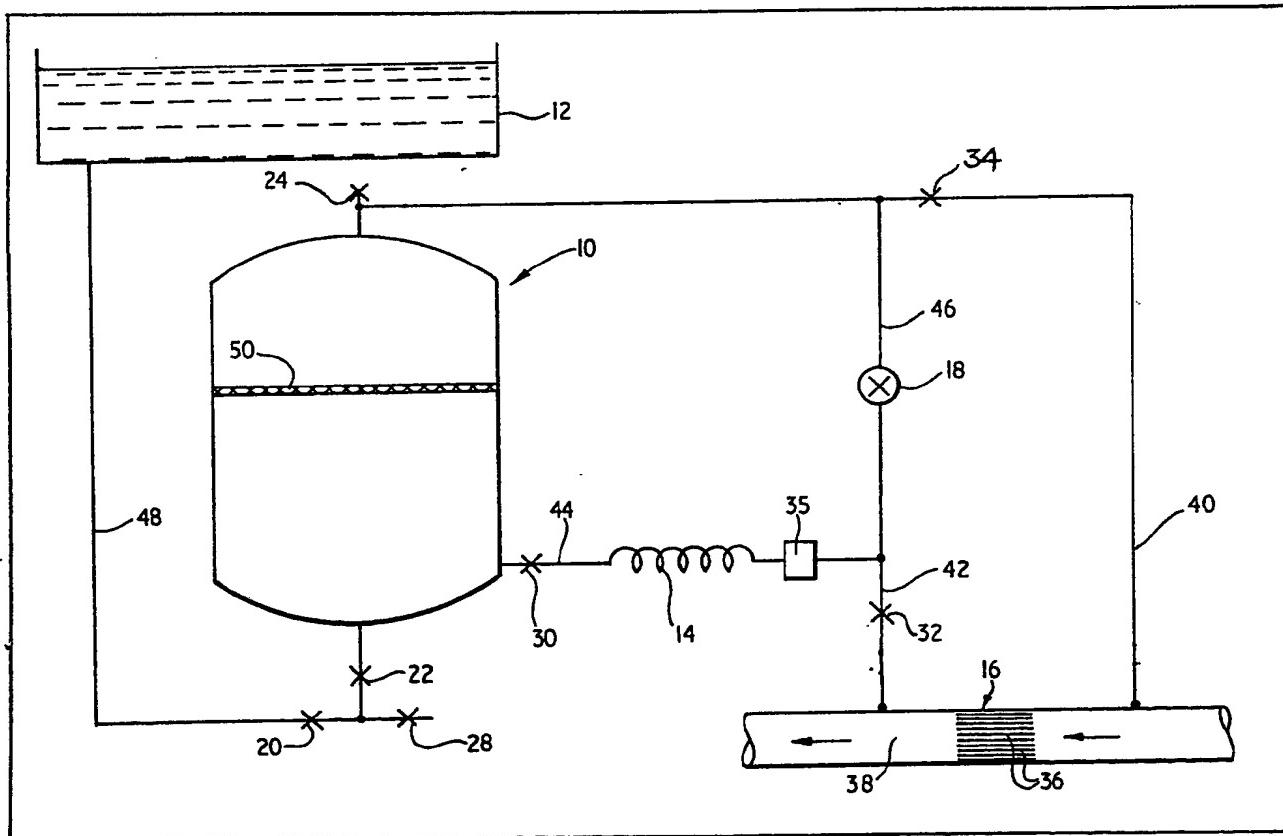
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 (71) Applicant  
 Paul Edward Ivan  
 Glouchkow, 17 Barton  
 View, Penrith, Cumbria  
 (72) Inventor  
 Paul Edward Ivan  
 Glouchkow  
 (74) Agents  
 Mewburn Ellis & Co.,  
 70—72 Chancery Lane,  
 London WC2A 1AD

**(54) Improvement in water sterilization plants**

(57) A water sterilization plant in which a flow restrictor (16) is used in the mains water pipe to provide a pressure difference, for operating the plant. A pressure vessel (10) is filled with a reagent from a tank (12). The upper part of the vessel (10) is connected to the mains water pipe (36) at the upstream end of the flow

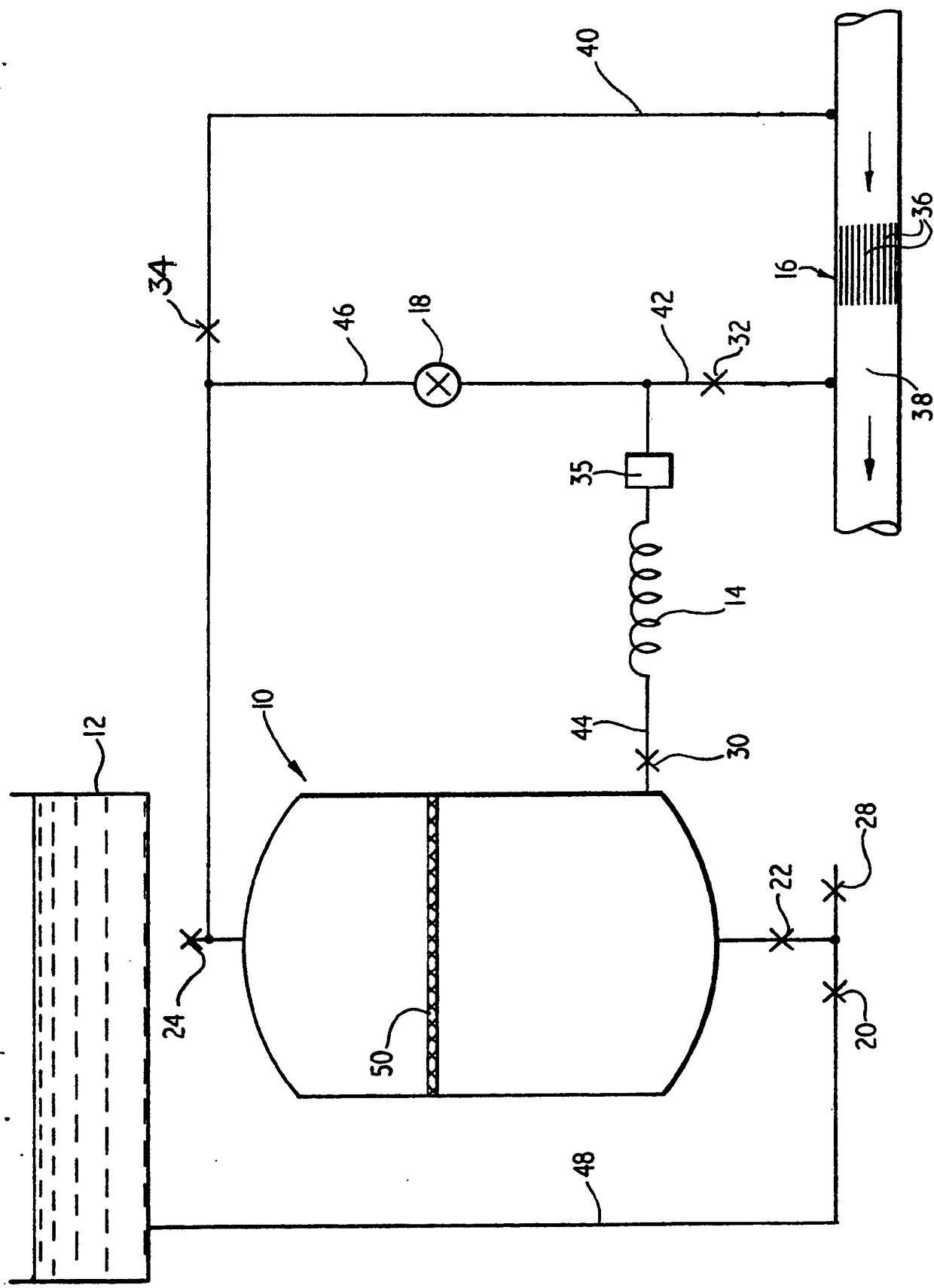
restrictor (16). The reagent is supplied to the mains water pipe at the downstream end of the flow restrictor through a capillary tube (14), by means of the pressure difference set up. A diaphragm (50) consisting of particulate material having a specific gravity between that of the water and reagent separates the two liquids in the pressure vessel. A by-pass valve (18) acts as a means to control the pressure applied to the pressure vessel.



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**SPECIFICATION****Improvement in water sterilization plants**

The present invention relates to water sterilization plants of the type designed to add a dose of a reagent to a fluid flowing in a pipe.

Most water supplied for domestic use from reservoirs is chlorinated. This is normally done by sophisticated equipment which pumps a predetermined quantity of chlorine gas into the water supply on leaving the filtration plant.

For small scale water supplies, this is done by the injection of a fine stream of bubbles of chlorine into the water by means of pressure from a cylinder containing pressurized chlorine gas.

An alternative system uses a water pump to drive a motor which introduces sodium hypochlorite into the water. This system suffers from the disadvantage that the sodium hypochlorite is corrosive and thus damages any mechanical parts which it comes into contact with.

Another system uses a chlorinator which comprises a pressure vessel containing a flexible bag of sodium hypochlorite. The flexible bag is not resistant to concentrated sodium hypochlorite and so the liquid inside is a diluted solution (10:1). This type of chlorinator therefore requires a very large pressure vessel.

It is therefore an object of the invention to provide a simple water sterilization plant requiring minimum maintenance and which can be used for supplying sterilized water to remote villages and communities.

According to the present invention there is provided a water sterilization plant including: a pressure vessel for containing a reagent to be mixed with the water; flow restricting means in a water supply pipe carrying water to be sterilized for creating a pressure difference; means for feeding the water from the pipe upstream of the flow restricting means to the upper section of the pressure vessel; means for feeding small quantities of the reagent into the water supply pipe downstream of the flow restricting means; and a self regulating diaphragm in the form of particulate material having a specific gravity between that of the water and the reagent in order to separate the water from the reagent.

Preferably the particulate material is methyl acrylate or nylon and is in the form of identical cylinders each having a diameter equal to its length.

Preferably water by-pass means are provided for the pressure vessel, said by-pass means containing flow regulating means whereby the pressure of the water applied to the pressure vessel and hence the quantity of reagent introduced into the water can be varied.

Preferably the means for feeding small quantities of the reagent into the water comprises a small bore capillary tube. This capillary tube is preferably made of flexible material coiled into a helix. One or more additional capillary tubes may be connectable in parallel for increasing the

quantity of reagent into the water.

The present invention will now be described in greater detail by way of example with reference to the accompanying drawing, wherein the sole figure is a schematic diagram of one preferred form of water sterilization plant.

Referring to the drawing, the water sterilization plant includes a pressure vessel 10, a tank 12, a small bore pipe 14 acting as a capillary tube, a flow restrictor 16, a control valve 18, valves 20, 22, 24, 28, 30, 32 and 34, and a sight glass 35.

The flow restrictor 16 comprises a number of parallel plates 36 mounted in a pipe 38 which carries the mains water from the reservoir or other source to the village or community where it is to be distributed to the individual houses. One end of a pipe 40 is connected to the pipe 38 upstream of the flow restrictor 16, and its other end is connected to the top of the pressure vessel 10. A second pipe 42 is connected between the mains pipe 38 downstream of the flow restrictor 16 and the sight glass 35. A third pipe 44 containing the valve 30 connects the small bore pipe 14 to the lower end of the pressure vessel 10. The other end of the small bore pipe 14 is connected to the sight glass 35. The small bore pipe 14 is a thin flexible capillary tube which is 1 to 30 m long coiled into a helix and having a bore diameter of between 0.5 and 2.0 mm. A fourth pipe 46 which contains the control valve 18 therein is connected between the two pipes 40 and 42, and acts as a by-pass to the pressure vessel 10.

A fifth pipe 48 connects the tank 12 with the bottom of the pressure vessel 10. The valves 20 and 22 are situated in the pipe 48 near the point of connection with the bottom of the pressure vessel 10. The valve 28 is open to the atmosphere on one side and is used to drain the pressure vessel when necessary for maintenance purposes. The valve 24 is open to the atmosphere on one side and is used for recharging the pressure vessel with reagent. The valve 30 is located in the pipe 44 near the point of connection to the pressure vessel 10. The valves 32 and 34 are located in the pipes 42 and 40 respectively near the points where these two pipes are joined to the pipe 46.

The pressure vessel 10 is provided with a self regulating diaphragm 50 consisting of particulate material having a specific gravity between that of the water and the reagent. In the particular

example described the particulate material is in the form of methyl acrylate cylinders having a diameter of 10 mm and a length of 10 mm. These have a specific gravity of 1.20 which is slightly less than the specific gravity of 1.23 for sodium

hypochlorite which is used as the reagent. Accordingly the cylinders of methyl acrylate material float on the surface of the sodium hypochlorite and thus form a barrier between the sodium hypochlorite and the water at the top of the pressure vessel 10.

In an alternative form, the particulate material is nylon.

In order to initially charge the pressure vessel with reagent fluid from the tank 12, all valves are

closed with the exception of valves 20, 22 and 24. Sodium hypochlorite from the tank 12 then flows by gravity into the bottom of the pressure vessel 10 lifting the diaphragm 50 as the pressure vessel fills up. The water in the pressure vessel is discharged from the valve 24. When reagent fluid starts to issue from the valve 24, the valves 20, 22 and 24 are all closed. In order to connect the apparatus into the system so that it can purify the water in the mains pipe 38, the valves 30, 32 and 34 are opened. The control valve 18 is adjusted to regulate the pressure of water applied to the top of the water vessel 10. Due to the pressure difference caused by the flow restrictor 16, reagent fluid is forced through the small bore pipe 14 and drips through the sight glass 35 before mixing with water in the pipe 42 which has passed through the control valve 18. The sodium hypochlorite is thoroughly mixed with the water before being discharged into the mains pipe 38 through the valve 32.

In a modified form two or more capillary tubes 16 can be provided in parallel and arranged to be switched into or out of the system according to requirements. Under normal conditions the desired degree of sterilization can be obtained by only one capillary tube, but should the water become unduly dirty an additional tube or tubes can be switched into the system in parallel in order to increase the quantity of sodium hypochlorite added. The system may include means for detecting the "dirtyiness" of the water and automatically adjusting the number of capillary tubes connected in parallel according to the detected "dirtyiness".

In a further modified form electronic detecting means in the form of an optical or capacitative sensor can be provided in order to detect when the level of the sodium hypochlorite falls below a given level, so that the pressure vessel can be recharged from the tank.

Where the plant includes electronic equipment, this may be made in integrated form and powered by a dry battery or batteries, or alternatively a rechargeable accumulator such as a car battery.

The above described water sterilization plant is easy to construct and operate, and moreover it requires only minimum maintenance apart from needing to be regularly recharged with sodium hypochlorite.

Accordingly, it is very suitable to be used with water supplies to remote areas, villages and communities which normally receive their water supplies direct from small reservoirs or springs in the hills.

#### CLAIMS

1. A water sterilization plant including: a

- pressure vessel for containing a reagent to be mixed with the water; flow restricting means in a water supply pipe carrying water to be sterilized, for creating a pressure difference; means for feeding the water for the pipe upstream of the flow restricting means to the upper section of the pressure vessel; means for feeding small quantities of the reagent into the water supply pipe downstream of the flow restricting means; and a self regulating diaphragm in the form of particulate material having a specific gravity between that of the water and the reagent in order to separate the water from the reagent.
- 2. A water sterilization plant according to Claim 1, wherein the particulate material is methyl acrylate.
- 3. A water sterilization plant according to Claim 1, wherein the particulate material is nylon.
- 4. A water sterilization plant according to Claim 2 or 3, wherein the particulate material is in the form of identical cylinders each having a diameter equal to its length.
- 5. A water sterilization plant according to any one of the preceding claims, wherein water bypass means are provided for the pressure vessel, said bypass means containing flow regulating means whereby the pressure of the water applied to the pressure vessel and hence the quantity of reagent introduced into the water can be varied.
- 6. A water sterilization plant according to any one of the preceding claims, wherein the means for feeding small quantities of the reagent into the water comprises a small bore capillary tube.
- 7. A water sterilization plant according to Claim 6, wherein the capillary tube is made of flexible material coiled into a helix.
- 8. A water sterilization plant according to Claim 6 or 7, wherein a plurality of capillary tubes are provided in parallel, and means are provided for connecting one or more of the additional tubes into the system according to the degree of "dirtyiness" of the water.
- 9. A water sterilization plant according to any one of the preceding claims, including means for detecting when the level of the diaphragm has fallen below a predetermined level to enable the pressure vessel to be recharged with reagent.
- 10. A water sterilization plant according to Claim 6 or 7, wherein a sight glass is provided between the means for feeding the reagent and a point downstream of the flow restricting means.
- 11. A water sterilization plant constructed and arranged to operate substantially as herein described with reference to and as illustrated in, the accompanying drawing.

**PATENT COOPERATION TREATY**  
**PCT**

**INTERNATIONAL SEARCH REPORT**

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No.	International filing date (day/month/year)	(Earliest) Priority Date (day/month/year)
PCT/GB 00/ 03157	15/08/2000	23/08/1999
Applicant		
BAE SYSTEMS PLC		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
  - the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :
  - contained in the international application in written form.
  - filed together with the international application in computer readable form.
  - furnished subsequently to this Authority in written form.
  - furnished subsequently to this Authority in computer readable form.
  - the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
  - the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished
- 2.  Certain claims were found unsearchable (See Box I).
- 3.  Unity of Invention is lacking (see Box II).
- 4. With regard to the title,
  - the text is approved as submitted by the applicant.
  - the text has been established by this Authority to read as follows:

5. With regard to the abstract,

- the text is approved as submitted by the applicant.
- the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

- as suggested by the applicant.
- because the applicant failed to suggest a figure.
- because this figure better characterizes the invention.

3

None of the figures.



## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/ 0/03157

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 G01S3/78 G01S3/781

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

INSPEC, EPO-Internal, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 26514 A (RUSCHIN SHLOMO ;UNIV RAMOT (IL) 24 July 1997 (1997-07-24) claims 1,3,4	1
Y	WO 97 41460 A (MONTGOMERY HARVEY J ;PEARSON WILLIAM A (US); BAUER HELMUTH (US); J) 6 November 1997 (1997-11-06) * Summary of the Invention *	10
A	claim 14	2-9, 11-23

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

30 October 2000

Date of mailing of the international search report

07/11/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.  
Fax: (+31-70) 340-3016

Authorized officer

Ó Donnabháin, C



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International Application No

PCT/00/03157

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9726514	A 24-07-1997	AU 1107597	A	11-08-1997
		US 6118119	A	12-09-2000

WO 9741460	A 06-11-1997	AU 723298	B	24-08-2000
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		CA 2250751	A	06-11-1997
		EP 0939908	A	08-09-1999
		NO 984582	A	01-12-1998

